

UNITED STATES DEPARTMENT OF THE INTERIOR  
BUREAU OF MINES

**Mineral investigation of the Lime Hills, Narrows, and Sand Cove  
Wilderness Study Areas, Mohave County, Arizona**

U.S. Bureau of Mines Mineral Land Assessment  
MLA 21-83  
1983

By  
Briggs, J.P

This open file report summarizes the results of a Bureau of Mines wilderness study and will be incorporated in a joint report with the U.S. Geological Survey. The report is preliminary and has not been edited or reviewed for conformity with the U.S. Bureau of Mines editorial standards. Work on this study was conducted by personnel from Intermountain Field Operations Center, Building 20, Denver Federal Center, Denver, CO 80225.

abstracted 12/14/83 JB

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WILDERNESS STUDY AREAS, MOHAVE COUNTY, ARIZONA

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Mineral Surveys  
Related to Bureau of Land Management  
Wilderness Study Areas

In accordance with the provisions of the Federal Land Policy and Management Act (Public Law 94-579, October 21, 1976), the Geological Survey and the Bureau of Mines conduct mineral surveys on certain areas classified as wilderness study areas. The results of a mineral survey of the Lime Hills, Narrows, and Sand Cove Wilderness Study Areas, Mohave County, Arizona, are reported in this publication.

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MINERAL INVESTIGATION OF THE LIME HILLS, NARROWS, AND  
SAND COVE WILDERNESS STUDY AREAS, MOHAVE COUNTY, ARIZONA

By John P. Briggs, Bureau of Mines

INTRODUCTION

During 1981 the Bureau of Mines conducted a field investigation of the Bureau of Land Management's Lime Hills, Narrows, and Sand Cove Wilderness Study Areas (WSA's), Mohave County, Arizona as part of a joint effort with the Geological Survey to make a mineral survey of the area. Surface workings and outcrops were examined and samples taken from rock sections that appeared to represent most of the mineralized area. Complete analytical results and sample descriptions are available for public inspection at the Bureau of Mines, Intermountain Field Operations Center, Building 20, Denver Federal Center, Denver, Colo. Part of the area also was examined and sampled in 1979 by L. W. Hamm, Bureau of Mines (Villalobos and Hamm, 1980), during a mineral resource study of the Paiute Primitive Area.

Location, size, and geographic setting

The three study areas encompass 60,700 acres in northwest Mohave County. Lime Hills WSA consists of 12,900 acres, Narrows WSA consists of 7,700 acres, and Sand Cove WSA consists of 40,100 acres. The three wilderness study areas border the Paiute Primitive Area, with the Narrows WSA adjoining it on the north, Lime Hills WSA on the northeast and the east, and Sand Cove WSA on the south (fig. 1). The community of St. George, Utah, lies 19 mi northeast of Narrows WSA, and Mesquite, Nev., is 14 mi southwest via Interstate 15. All three study areas are accessible by a network of graded roads, but access within the study areas is limited to jeep, pack, and foot trails.

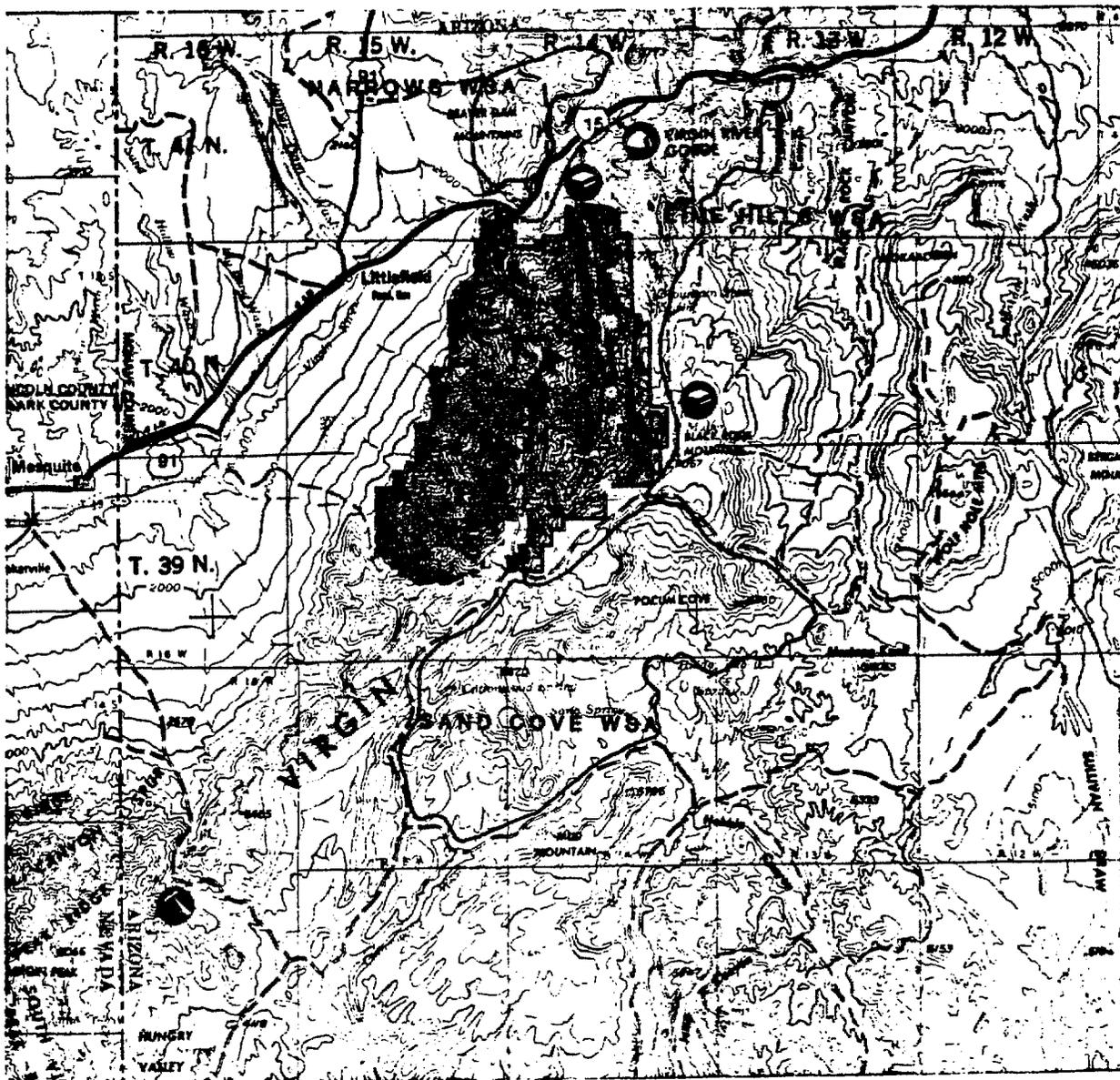


Figure 1.--Index map of the Lime Hills, Narrows, and Sand Cove Wilderness Study Areas, Mohave County, Arizona.

### Mining activity

Claim staking and prospecting are the only minerals-related activities evident in the Narrows and Lime Hills WSA's. Principal efforts centered on a gypsum deposit at Cedar Wash in the northeastern part of the Narrows WSA. Numerous prospect pits, trenches, and dozer cuts are in evidence. Although the deposit was staked and extensively prospected in the past, no evidence exists of it having been worked in recent years. The gypsum deposit may have been mined, to a limited extent, for agricultural purposes.

Evidence of minerals-related activities in the Sand Cove WSA consisted of two prospect pits and a geophysical prospecting party met during the course of fieldwork. The geophysical party was part of an oil and gas exploration program.

No patented mining claims were on file as of January 1983, for any of the three study areas. Oil and gas leases cover all of the Sand Cove WSA and parts of the Lime Hills and Narrows WSA's.

### MINING DISTRICTS AND MINERALIZED AREAS

No formal mining districts are within or near the Lime Hills, Narrows, or Sand Cove Wilderness Study Areas. Minerals-related activities within these study areas centered on Permian and Triassic gypsum deposits, base and precious metals in Paleozoic limestones (table 1), and oil and gas exploration in the Triassic, Permian, and Pennsylvanian formations that underlie the areas.

### Gypsum

Gypsum deposits have been prospected in three areas. Small bedded gypsum deposits in the Triassic Moenkopi Formation at Mountain Sheep Wash and the Permian Kaibab Formation in Purgatory Canyon have been prospected in and near the northern part of the Lime Hills WSA. A larger gypsum deposit has

been worked at Cedar Wash along the northeast boundary of the Narrows WSA (pl. 1). Moore (1972) assigned the gypsum to the Pennsylvanian and Permian Callville Limestone. The Cedar Wash deposit contains about 300 ft of massive, granular gypsum, interbedded with numerous limestone beds 6 in. to 4 ft thick and crops out over an area of about 480 acres within and adjacent the study area. Disregarding the limestone interbeds and assuming a uniform thickness of 300 ft and a bulk density of 144 lbs per cubic foot, the deposit contains about 450 million tons of gypsum.

Assays of seven samples from the Cedar Wash deposit ranged from 67.3 to 78.4 percent  $\text{CaSO}_4$  and from 19.3 to 26.8 percent  $\text{H}_2\text{O}$  (table 2). These analyses indicate that the grade of the gypsum is comparable to that of deposits being mined in other parts of the United States (Ladoo and Meyers, 1951; Bradley, 1932).

#### Oil and gas

Potentially oil and gas bearing Triassic, Permian, and Pennsylvanian formations underlie the study areas. Oil and gas shows have been reported in the region from drill holes in these rocks and several small oil and gas fields in central and western Utah are producing from them (Cook, 1963). Also, minor oil seeps in the Moenkopi are present along the Hurricane Fault (sec. 3, T. 43 S., R. 13 W.), about 10 mi northeast of Lime Hills WSA and along the Virgin River (secs. 28 and 29, T. 41 S., R. 12 W.), about 20 mi northeast of Lime Hills WSA (Ritzma, 1973). Numerous faults cut through the study areas possibly creating subsurface structural traps (Moore, 1972). However, three exploratory oil and gas wells drilled 2 to 3.5 mi east of the area were dry. Two of the exploratory wells (sec. 6, T. 41 N., R. 12 W.) were drilled to the Moenkopi, the most productive horizon in the region.

In the Narrows WSA, the Triassic, Permian, and Pennsylvanian strata crop out at the surface and are unlikely to be oil bearing.

#### Other minerals

The only known metallic mineral occurrences within the three study areas are in the southern part of the Lime Hills WSA. There, the Goddess and South End workings consist of one adit, two shafts, and two prospect pits. These workings were opened in Paleozoic limestones in search of base and precious metals.

At the Goddess workings, lead- and zinc-bearing minerals occur as open-space fracture filling in a northeast trending karst zone. One 5 ft wide sample taken from the upper part of a caved shaft and one dump sample taken from the same shaft contained 0.5 and 2.9 oz silver per ton, 1.5 and 2.2 percent lead, and 2.7 and 7.2 percent zinc (table 3). Ten tons of ore were shipped from the Goddess workings (P. Lamoreaux, claim owner, oral commun., 1979). Villalobos and Hamm (1980) identified the South End workings as being located in a breccia pipe in Permian limestone. These workings consist of a shaft of unknown depth and a caved connecting adit. Assay results showed only minor concentrations of metallic minerals, although one sample from an apparent ore stockpile contained 5.4 percent copper and 1.15 percent arsenic (table 3). Examination of the geology, mines and prospects, mining claims, and a geochemical survey in the Goddess and South End areas revealed no substantial indications of significant amounts of near-surface base or precious metal mineralization (Villalobos and Hamm, 1980).

Two prospect pits opened in the Shinarump Conglomerate, near the western edge of the Sand Cove WSA (unsurveyed sec. 10, T. 15 W., R. 38 N.) are the only indications of any uranium exploration within the areas. The Shinarump

Conglomerate is a known uranium host rock in other parts of the Colorado Plateau; however, examination and sampling of the Shinarump Conglomerate indicated no radioactivity above background levels (table 4).

Limestone and sand and gravel deposits are plentiful in all three study areas, and nearby areas.

#### CONCLUSIONS

Examination of the geology, mines and prospects, mining claims, and a geochemical survey (Villalobos and Hamm, 1980) in the Lime Hills WSA and vicinity revealed no substantial indications of near-surface base or precious metals.

Lime Hills and Narrows WSA's contain bedded gypsum deposits. Site specific mineral resources include 480 acres of a 300-ft thick gypsum outcrop at Cedar Wash in the northeast corner of the Narrows WSA and smaller deposits at Mountain Sheep Wash and Purgatory Canyon in and near the northeastern boundary of the Lime Hills WSA. Assays show the grade of the Cedar Wash deposit to be equivalent to commercial deposits in other States and suitable for agricultural applications.

Oil and gas leases have been issued in all three study areas; however, the three exploratory oil and gas holes that have been drilled in proximity to the study area have all been dry.

Limestone and sand and gravel deposits are plentiful in all three study areas; however, abundant similar deposits occur outside the study areas.

No uranium values were detected in prospects in the Shinarump Conglomerate near the western edge of the Sand Cove WSA.

## REFERENCES

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- Cook, E. F., 1963, Geology and oil possibilities of Washington County in A. L. Crawford, ed., Oil and gas possibilities of Utah, re-evaluated: Utah Geological and Mineralogical Survey Bulletin 54, p. 303-318.
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- Ritzma, H. R., 1973, Oil-impregnated rock deposits of Utah (reprinted 1974): Utah Geological and Mineralogical Survey Map 33, scale 1:1,014,000 (1 in. = approx. 16 mi.), 2 sheets.
- Villalobos, H. A., and Hamm, L. W., 1980, Summary report of the mineral resource appraisal of the Paiute Instant (Primitive) Study Area, Mohave County, Arizona: U.S. Geological Survey Miscellaneous Field Studies Map MF-1160-D.

Table 1.--Mining and mineralized areas in the Lime Hills, Narrows, and Sand Cove Wilderness Study Areas, Mohave County, Arizona

[Sample number corresponds to locality shown on map]

Sample Nos.	Name (location)	Resource(s)	Production and development	Description	References
<u>LIME HILLS WILDERNESS STUDY AREA</u>					
LH 0101	NOT LISTED IN M.L.W. Purgatory Canyon (NE1/4 sec. 28, T. 41 N., R. 13 W.).	Gypsum	Prospect, no production.	Massive granular gypsum beds in Permian Kaibab Formation crop out in canyon wall.	None.
LH 0100	POT LISTED IN M.L.W. Mountain Sheep Wash (NE1/4 sec. 10, T. 40 N., R. 14 W., POT LISTED IN M.L.W.)	Gypsum	Outcrop, no production.	Diapir in Triassic Moenkopi Formation; massive, granular gypsum crops out over 15-acre area.	None.
PA 2734- 2736	POT LISTED IN M.L.W. South End breccia-pipe shaft (SW1/4 sec. 19, T. 39 N., R. 14 W., unsurveyed).	Copper	One shaft of undetermined depth and caved connecting adit; production unknown.	Localized breccia-pipe deposit extends to unknown depth.	Hamm, 1980.
PA 2737- 2739, 2752, 2754- 2758	77113 # 716 Goddess workings ✓ (SW1/4 sec. 17, T. 39 N., R. 14 W., unsurveyed).	Silver, lead, zinc.	10 tons (P. Lamoreaux, claim owner, oral commun., 1979); shaft, caved at approximately 10 ft; trench (caved adit?) 40 ft long; pit.	Limestone/calcite karst zone; locally mineralized as open-space fillings.	Hamm, 1980.

Table 1.--Mining and mineralized areas in the Lime Hills, Narrows, and Sand Cove  
Wilderness Study Areas, Mohave County, Arizona--Continued

[Sample number corresponds to locality shown on map]

Sample Nos.	Name (location)	Resource(s)	Production and development	Description	References
<u>NARROWS WILDERNESS STUDY AREA</u>					
NA 0100-0106	✓ <sup>MU-744</sup> Cedar Wash (secs. 3 and 10, T. 41 N., R. 14 W.).	Gypsum	No known production; numerous prospect pits, trenches, and dozer cuts that probably represent assessment work.	Gypsiferous member of the Pennsylvanian and Permian Callville Limestone; approximately 300 ft of massive granular gypsum interbedded with numerous limestone beds 6 in. to 4 ft thick; area of outcrop approximately 480 acres.	Moore, 1972.
<u>SAND COVE WILDERNESS STUDY AREA</u>					
SC 0100, 0101	✓ <sup>MU-248A</sup> <u>Cottonwood Wash</u> (sec. 10, T. 38 N., R. 15 W., unsurveyed).	Uranium(?) vanadium(?).	Prospects, no production.	Triassic Shinarump Conglomerate; yellow-brown, chert-pebble channel deposit, containing petrified wood and carbon trash.	None.

Table 2.--Analyses of gypsum and gypsite samples from the Lime Hills and Narrows  
Wilderness Study Areas, Mohave County, Arizona

[Components determined by chemical analysis; values reported in percent; n.a., not analyzed]

Sample No.	Sample type (feet)	CaSO <sub>4</sub>	Water Free and Combined	Insol. residue	Iron	Sodium	Magnesium	Manganese
<u>LIME HILLS WILDERNESS STUDY AREA</u>								
LH 0100	Chip, vertical (3.0)	80.8	19.3	1.5	0.12	0.03	0.04	0.002
LH 0101	Grab	73.3	20.3	n.a.	.19	.03	3.30	.003
<u>NARROWS WILDERNESS STUDY AREA</u>								
NA 0100	Chip, vertical (4.0)	78.4	20.51	2.00	.04	.02	.03	.001
NA 0101	Chip, vertical (2.0)	67.3	21.31	5.90	.18	.13	.65	.002
NA 0102	Chip, vertical (4.0)	72.4	19.34	n.a.	.31	.04	5.10	.006
NA 0103	Chip, vertical (10.0)	71.3	20.61	n.a.	.14	.03	.63	.002
NA 0104	Select	77.8	26.86	0.010	.02	.01	.02	.001
NA 0105	Select	76.1	20.69	1.4	.03	.01	.02	.001
NA 0106	Select	77.4	20.83	1.70	.005	.01	.12	.001

Table 3.--Analyses of samples from the Lime Hills Wilderness Study Area, Mohave County, Arizona,  
for base and precious metals (after Hamm, 1980)

[Gold and silver determined by fire assay. Copper, lead, zinc, and arsenic determined by chemical analysis. Tr, trace; ---, not detected; ND, not determined; <, less than. To convert oz/ton to g/ton, multiply by 34.29]

No.	Sample Type	Gold oz/ton	Silver oz/ton	Copper percent	Lead percent	Zinc percent	Description
PA 2734	Random grab.....	---	0.4	5.4	0.003	0.023	Gray and red limestone, locally brecciated; granite xenoliths(?), copper carbonate; arsenic content 1.15 percent; surface stockpile near shaft.
PA 2735	.....do.....	---	---	ND	ND	ND	Granite and gray limestone; surface dump near shaft.
PA 2736	.....do.....	---	---	ND	ND	ND	Gray limestone, red brecciated limestone; caved adit dump.
PA 2737	.....do.....	---	.5	0.003	1.5	2.7	Limestone and calcite; traces of galena and sphalerite; surface dump near shaft.
PA 2738	5.0-ft chip.....	Tr	2.9	.004	2.2	7.2	Limestone; galena and zinc minerals with calcite as open-space fracture filling; shaft.
PA 2739	4.0-ft chip.....	---	.1	.014	.22	.31	Limestone; galena and zinc minerals with calcite as open-space fracture filling; trench.
PA 2752	Random grab.....	---	---	.001	.25	.39	Limestone and calcite; traces of galena and sphalerite; trench dump.
PA 2754	2.7-ft chip.....	Tr	.1	.037	.10	.20	Limestone, hematite-stained, brecciated; prospect pit.
PA 2755	3.0-ft chip.....	---	.2	.053	.26	.74	Limestone and clay, limonite-stained, brecciated; prospect pit.
PA 2756	2.0-ft chip.....	---	---	.008	.14	3.7	Limonite-stained vein in limestone; prospect pit.
PA 2757	3.6-chip.....	Tr	---	.004	.18	.19	Limestone and calcite, iron oxides; prospect pit.
PA 2758	Random grab.....	---	1.1	.010	.53	3.0	Limestone with iron oxides; prospect pit dump.

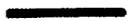
Table 4.--Analyses of samples from the Sand Cove  
Wilderness Study Area, Mohave County, Arizona

[Uranium determined by radiometric methods,  
vanadium by atomic absorption; <, less than]

Sample No.	Sample type (feet)	Uranium oxide (percent)	Vanadium pentoxide (percent)
SC 0100	Chip, select	<0.001	<0.02
SC 0101	Chip, vertical, (4.0)	<.001	<.02

EXPLANATION FOR MINE AND PROSPECT MAP

APPROXIMATE BOUNDARIES OF THE LIME HILLS, NARROWS, AND SAND COVE WILDERNESS STUDY AREAS



APPROXIMATE AREA UNDERLAIN BY GYPSUM



UNPATENTED MINING CLAIMS



BOUNDARY OF LAND LEASED FOR OIL AND GAS--Pattern on leased side



LOCALITY OF SAMPLED OUTCROP--Showing sample number

© NA 0104

SURFACE OPENINGS--Showing sample locality number; symbol may represent more than one working

X SC 0101

Prospect pit

+ PA 2734-  
2736

Caved adit

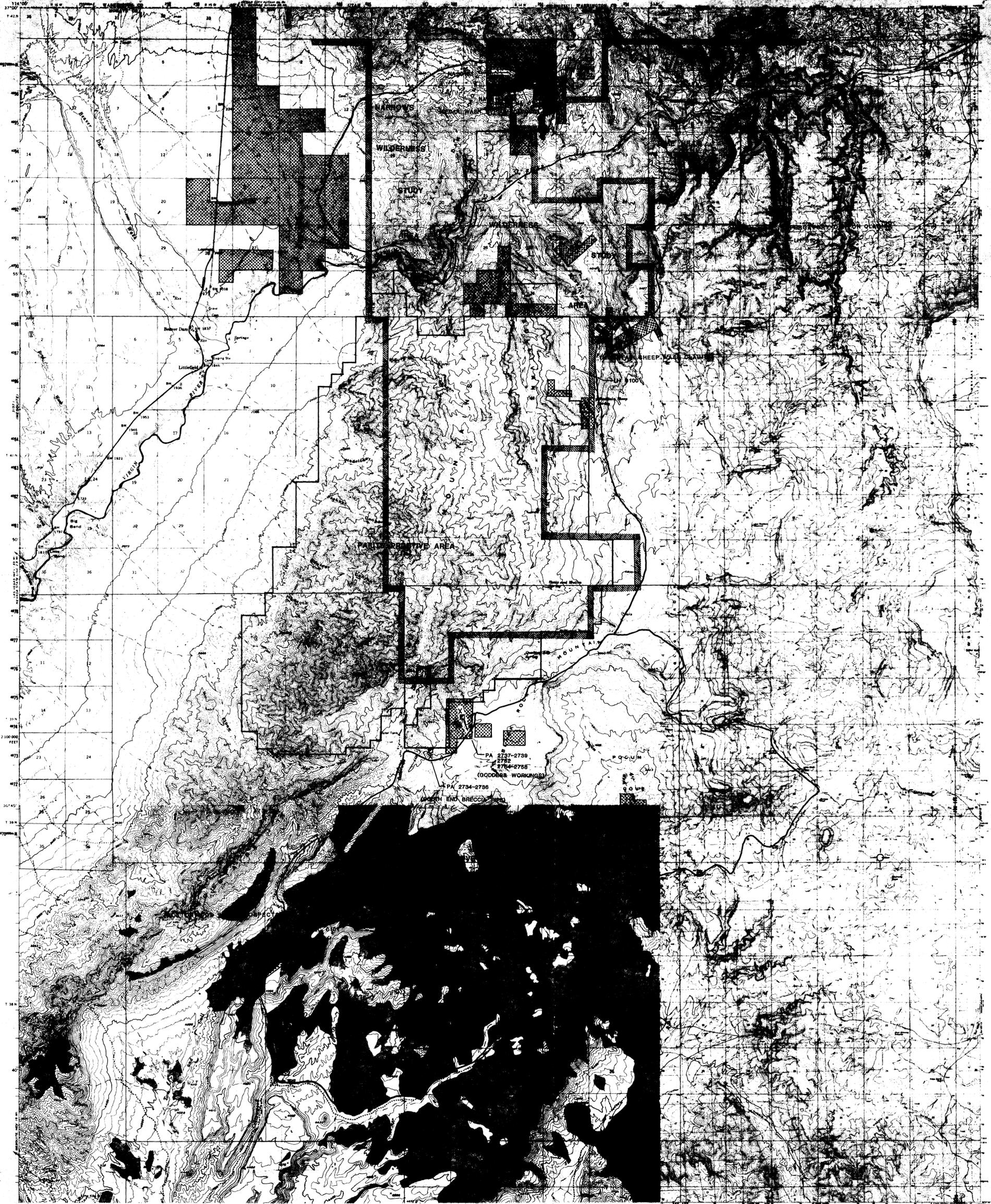
■ PA 2737-  
2739

Shaft



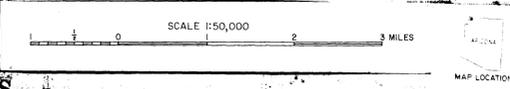
Oil and gas well, dry and abandoned

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY



Base from U.S. Geological Survey, 1:62,500  
Cane Spring and Littlefield, 1954; and  
1:24,000 Muehlag Knob, Padagonia Canyon  
and Wolf Hole Mt West, 1979.

MINE AND PROSPECT MAP OF THE  
LIME HILLS, NARROWS, AND SAND COVE WILDERNESS STUDY AREAS,  
MOHAVE COUNTY, ARIZONA



by  
John P. Briggs  
U.S. Bureau of Mines

Field work completed in 1981  
by John P. Briggs, assisted  
by William G. ...